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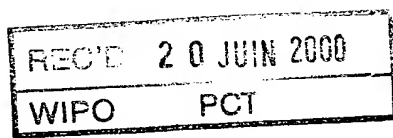
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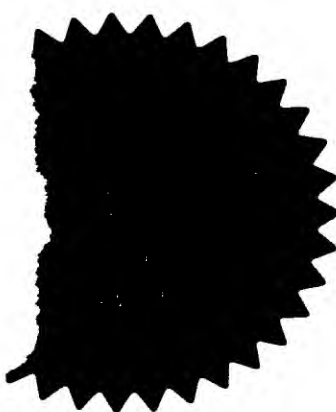
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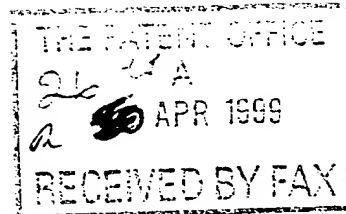
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## A CLOSURE CASING

DUPLICATE

The present invention relates generally to a closure case, and particularly to a closure casing for enclosing one or more elongate objects such as pipes or cables, which latter  
5 term will be understood hereinafter to include both electrically conductive cables and optical cables comprising bundles of optical fibres.

Optical fibres are increasingly used in telecommunications systems and a number of techniques have been developed for joining such fibres at particular points within a  
10 communications network. Likewise, electrically conductive cables or wires have to be joined at certain places within the network and at all such junctions closure casings are required in order both to support the connection and to provide protection against environmental agencies such as moisture and dust.

15 Optical fibres may be joined in a number of ways, utilising techniques such as splicing or devices such as couplers or splitters. A common feature of all such connections, however, is the requirement for a closure casing which has means for allowing ingress of one or more cables or bundles of fibres at one end and for egress of one or more cables or bundles of fibres at the other. Such closure casings also find particularly  
20 utility where it is necessary to install equipment at an intermediate point along a transmission line. Such equipment may, for example, include repeaters, amplifiers, boosters, attenuators or other such equipment (which equipment is mentioned by way of example and is not intended to be an exhaustive list nor to prejudice the generality



of the invention) but whatever equipment the closure casing encloses the common features nevertheless remain that the casing must be capable of being sealed against environmental agencies and have sufficient strength and rigidity to resist external forces and protect the, sometimes delicate, components enclosed therein. Such closure casings may be used in circumstances where they are to be buried underground, or  
5 may be housed in cabinets or other locations within the network.

Although such closure casings must be capable of sealing securely against environmental agents it is very often necessary to gain access to the interior of the casing (so-called "re-entry" requirements) in order to make changes to the network or  
10 for maintenance purposes in the event of a failure or breakdown. This re-entry requirement means that a closure casing has to be fastened with releasable fasteners of one form or another and cannot be permanently secured such as by adhesive or welding of the components unless it is acceptable for the casing to be disposed of,  
15 upon re-entry, and replaced with a fresh casing. Economically, in view of the complexity of the structure, this is usually not viable.

The present invention seeks to provide a closure casing having releasable fasteners for securing the casing parts in the closed condition, and to a fastener for such a closure,  
20 which is releasable quickly and easily to allow an operator access to the interior of the closure casing.

One way in which this has been done in the prior art, is to provide the casing with a

surrounding ring or clamp which is held in its closure position by an over-centre clamp or toggle latch. WO96/33922 illustrates such a clamp. A disadvantage with such a structure lies in the relatively complex shape of the outside of the casing resulting from the presence of the over-centre clamps which makes the casing difficult  
5 to handle and requires extra space for it to be housed.

According to one aspect of the present invention a closure casing having two co-operating closure members defining an enclosed space between them when in a juxtaposed closure position is provided with means for holding the closure members  
10 together in the closure position comprising at least one over-centre or toggle clamp mechanism one part of which passes through openings in the closure members which are aligned when the closure members are in the said closure position, and engages a face of the closure member remote from the other part of the toggle clamp mechanism.

15 As used herein the term "toggle clamp" will be understood to relate to a mechanism comprising two parts pivotally engaged or engagable with respect to one another, one of which comprises a tension member and the other of which comprises an operating lever. The axis about which the two parts of the clamp are turnable with respect to one another is spaced from an effective point of contact between the operating lever  
20 member and a part of the closure which it engages, the arrangement being such that in turning about the pivot axis between the two clamp members from a release position to a clamped position the line of action through the contact point with the closure member is displaced transversely of the line of action between the pivotable



connection between the two clamp members and the contact point of the tension member with the other closure member, passing through a "centre" position in which the pivot axis and the said two lines of action are all aligned, at which point the tension applied to the tension member is at its greatest. In the closure position, therefore, the tension applied to the tension member holds the operating lever in its closed position.

Toggle clamps of this type are widely known and require no further explanation here.

The resilience in the mechanism is usually applied by a spring tension, by making the tension member of such a shape that it can be extended upon the application of a tensile force between each end (often this is achieved merely by shaping the tension member with a slight elbow) or by the provision of a separate spring of the toggle clamp mechanism acting between the tension member and the operating lever such that the spring is compressed as the operating lever moves towards its clamping position, passing a point of maximum compression as the two lines of action are aligned.

By passing one of the parts of the toggle clamp mechanism through aligned openings in the closure members it is possible to achieve a number of important benefits. First, unlike conventional toggle clamp mechanisms, the operating lever, and possibly also the tension member, need not project beyond the general outline of the closure casing. This, therefore, makes the outline of the closure casing much less irregular, and protects the operating lever of the toggle clamp mechanism from disturbance or

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damage by contact with adjacent parts.

Another important advantage lies in the possibility of orientating the toggle clamp mechanism such that the axis about which the two toggle clamp parts are pivotally  
5 connected need no longer necessarily be parallel to the closure line between the two closure casing members as has been necessary in the past. Indeed, it is a separate aspect of the present invention to provide a closure casing having two co-operating closure members defining an enclosed space between them when in a juxtaposed closure position, in which there is provided a toggle clamp mechanism having two  
10 relatively turnable parts which can be turned in relation to one another about an axis generally transverse the meeting line of the co-operating members of the closure casing.

In a preferred embodiment there may be a plurality of toggle clamps along an  
15 extended meeting line between two casing members which may be formed as two half-shells fitting together about co-operating respective perimetral rims.

In a preferred embodiment of the invention at least one of the closure members has a resilient element engageable by a part of the said toggle clamp mechanism and  
20 operable to apply a resilient resistance to the clamping movement thereof to hold the clamp in its locking position when moved thereto against the resistance exerted by the resilient element.

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Such resilient element may be a laminar resilient strip overlying surface portion of the casing.

- In embodiments of the invention in which the said closure members are co-operating half shells they may be provided with respective flanges around perimetral rims thereof which are brought together when the casing is closed, and in such an embodiment the said resilient element may comprise a strip or stringer lying along the length of at least one flange on one of the casing members.
- 10 In such arrangement the flange provided with the resilient strip may have a cavity therein adjacent the opening through which passes the said one part of the toggle clamp mechanism and across which the said resilient strip spans. Alternatively, of course, the resilient strip need not be rectilinear, but provided with an arcuate portion which is stressed towards a rectilinear configuration by the forces applied by the
- 15 toggle clamp upon closure.

- Preferably the said one part of the toggle clamp mechanism has a transverse projection for engaging the face of the closure member remote from the other part of the toggle clamp mechanism. The said transverse projection may be in the form of two
- 20 oppositely directed substantially symmetrical projections for engaging opposite sides of an opening in the said closure member, or may be in the form of a single hook for engaging one side of a said opening.

In the case of a closure casing having a clam shell configuration in which the two co-operating casing members are half-shells these may have a generally elongate form to define two opposite ends for entry and exit of cables or bundles of optical fibres, and in this case there may be a plurality of toggle clamp mechanisms spaced around  
5 at least part of the perimeter of the closure members.

In a preferred embodiment of the present invention the said other part of the toggle clamp mechanism comprises a body portion having two parallel sides with respective aligned openings or cavities for receiving respective pivot pins of the said one member  
10 such that the said one member is located, in use, between the said two parallel sides, and an operating tab or lever which projects from the body portion and lies substantially parallel to the surface of the co-operating closure member when the clamp is in its locking position.

15 Such a configuration allows the clamp to be manipulated manually, without requiring special tools, and this can be further encouraged by the provision on the said body portion of the said other part of the latch mechanism of a face extending generally transversely of the operating tab or lever. This may serve as a release member against which, in use, a force may be applied to release the clamp from its locking position.

20 Of course, in embodiments in which there are a plurality of such clamps, the force applied by each clamp is a fraction of the overall closure force, and this facilitates manual manipulation of the clamps avoiding the requirement for a manipulating tool which may be needed if only a single clamp is provided.

A closure casing according to the invention may further be provided with a sealing member located inwardly of the clamp or clamps for sealing the interior volume of the casing when closed.

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According to another aspect of the present invention a closure casing having two co-operating closure members defining an enclosed space between them when in a juxtaposed closure position is provided with closure means in the form of at least one toggle clamp mechanism comprising two relatively turnable parts which can be moved  
10 in relation to one another between an over-centre clamping or locking position in which the two parts apply a closing pressure to the two co-operating closure members, and a release position, and in which at least one of the closure members carries a resilient element which is stressed by the toggle clamp mechanism when the parts thereof are in the clamping position whereby to apply a resisting force to maintain the  
15 parts of the toggle clamp in their over-centre position and the two closure members pressed against one another.

The present invention also comprehends a toggle clamp mechanism as such, and according to a further aspect of the present invention an over-centre or toggle clamp  
20 mechanism for holding together two co-operating members of a closure casing comprises two clamp parts which are pivotally interengaged or interengagable, one clamp part being adapted to pass through aligned openings in the said two co-operating closure members and engage the closure member remote from the other

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clamp part.

In an alternative aspect of the present invention an over-centre or toggle clamp mechanism for holding together two co-operating members of a closure casing  
5 comprises two clamp parts which are pivotally interengaged or interengagable with one another, one clamp part being adapted to pass through aligned openings in the said two co-operating closure members and engage the closure member remote from the other clamp part, the said one clamp part having a transverse projection at or adjacent one end thereof and being turnable about an axis parallel to its length whereby to turn  
10 the transverse projection between engagement and release positions with respect to the said remote closure member.

The present invention also provides a fibre optic splice closure casing of the type having two closure members which fit together around respective perimetral rims, at  
15 least one of the members having a surrounding flange with a plurality of openings matching corresponding openings in the perimetral region of the other member, and a plurality of toggle clamps for holding the closure members together, each passing through a pair of said openings in the closure members.

20 Various embodiments of the present invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a first embodiment of the invention shown

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with two casing  separated;

Figure 2 is a perspective view similar to that of Figure 1 showing the parts exploded:

Figures 3, 4 and 5 are partial perspective views, on an enlarged scale, showing  
5 the operation of the toggle clamps of the embodiments of Figures 1 and 2;

Figure 6 is a schematic diagram illustrating the components of an alternative toggle clamp of the invention;

Figures 7a and 7b and 7c are three figures showing a further alternative embodiment of toggle clamp;

10 Figure 8 is a schematic exploded diagram illustrating the components of a further embodiment of toggle clamp; and

Figures 9 and 10 are two schematic sectional views illustrating a further embodiment of the invention.

15 Referring first to Figures 1 and 2, a fibre optic splice closure casing is generally indicated 11 and comprises an upper casing member 12 and a lower casing member 13. Such splice closure casings are known in themselves and the details thereof will not be described further in except to say that the casing members are respective half-shell structures with part-cylindrical formations 14, 15, 16 at one end defining cable  
20 entry ports in co-operation with corresponding structures (not visible in the drawings) in the lower casing member 13 to allow for the introduction of optical fibres into the interior of the casing 11 for splicing, connection by couplers or splitters or the like.

## 11

Around the perimeter of the upper casing member 12 extends a perimetral flange 17, there being a corresponding perimetral flange region 18 around the perimeter of the lower casing member 13. Each flange 17, 18 has an approximately rectangular outline comprising two longitudinal rectilinear sides and two transverse rectilinear sides of shorter dimension. For the purposes of the present invention only the nearer longer rectilinear side will be described in detail since the considerations concerning the structure and function of the other sides will be exactly the same. The flange 18 has a face 19 which faces towards the other flange 17 which has a corresponding flat face which is not visible in the drawings. Inwardly from the edge of the flat face 19 is a perimetral seal 20 extending around the flange and co-operating with a similar seal which acts to seal the interior of the closure casing 11 when the two casing members 12, 13 are fitted together with their flanges 17, 18 pressed in contact with one another.

Outwardly of the seal 20 the flange 18 has a plurality of elongate openings 21 spaced along its length and, correspondingly, the upper flange 17 has identical openings which cannot be seen in the drawing.

On the upper face of the flange 17 there is an overlying rectilinear resiliently flexible strip 22 (see Figure 2) having a corresponding series of slots 23 matching the openings 21 in the flange 18 and the corresponding openings (not shown) in the flange 17.

Likewise, on the face of the flange 18 remote from the flange 17 there is an overlying rectilinear resilient strip 24 likewise having slot-like openings 25 in positions which align themselves in register with the openings 21 in the flange 18 when the strip 24



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is placed in position. When the members of the closure casing are assembled in the closure position, therefore, the flanges 17, 18 and the rectilinear strips 22, 24 are all positioned closely adjacent to one another with their openings 21, 23 and 25 all in register.

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For holding the flanges 17, 18 together there are provided a plurality of over-centre toggle clamps generally indicated 26 each of which is identical and only one of which, therefore, will be described in detail hereinafter. Each toggle clamp 26 comprises two parts, namely a body part 27 and a tension link 28. The tension link 28 comprises a  
10 flat generally rectilinear element having a transversely projecting hook 29 at one end. The tension link 28 has a transverse hook 29 projecting in the plane of the link 28 transversely of a line joining its opposite ends.

At its other end the tension link 28 has two transversely projecting spigots 30, 31  
15 defining an axis which is orthogonal both to the length of the tension link 28 and the direction of the transverse projection of the hook 29. The link 28 is substantially rigid and, being rectilinear, substantially inextensible at least in response to the forces likely to be exerted on it in use.

20 The other part of the toggle clamp mechanism comprises a combined body and operating lever. It comprises a generally cube-like main body portion 32 from which project two parallel flanks 33, 34 having correspondingly curved edges 35, 36. The inwardly facing surfaces of the flanks 33, 34 have sockets or cavities for receiving the

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transverse spigots 30, 31 of the tension link 28. From the side opposite that from which the parallel flanks 33, 34 project there is an operating tab or lever 38.

In use the spigots 30, 31 of the tension link 28 are fitted into the cavities or seats 37  
5 and the tension link 28 inserted through the aligned openings 21, 23, 25 as illustrated in Figure 3, with the body part 27 being orientated such that the operating lever or tab 38 is approximately in line with the tension link 28. Thereafter the body 27 is turned, clockwise as illustrated in Figure 4, about the inter-engaging pivot between the spigots 30, 31 and the cavities 37 whilst the curved edges 35, 36 are in contact with the upper  
10 spring strip 22 and the hook 29 engages the lower spring strip 24. The outline of the curved edges 35, 36 is such that in turning the body 27 between the orientation illustrated in Figure 4 and that illustrated in Figure 5, displaced approximately 90° with respect to the former, the mechanism passes through a position in which the pivotal interconnection of the spigots 30, 31 in the cavities is spaced further from the  
15 contact point between the edges 35, 36 and the spring strip 22 than is the case on either side of this mid-point such that, having turned the body 27 beyond this point the tension on the tension link 28, exerted by the spring strip 22, 24 in a manner which will be described in more detail below, causes the body 27 to be turned in a clockwise direction as seen in Figures 4 and 5, to the clamping position illustrated in Figure 5.  
20 By so turning all the toggle clamps the perimetral flanges of the casing member 12, 13 can be pressed together to seal the closure casing 11 in its closed position. It will be noted that, in particular, the axis about which the toggle clamp body 27 turns in relation to the tension link 28 is perpendicular to the length of the meeting line

between the two flanges 17, 18 such that at no time between the fully open and fully closed position does the toggle clamp body 27 project beyond the outline defined by these flanges.

- 5 The manner in which the spring strips 23, 24 exert their resilient action is described in relation to Figure 6 which is a schematic representation of a part of a closure casing 11 showing two short sections of the flanges 17, 18, the openings 21 in the lower flange 18 and openings 41 (not previously illustrated in Figures 1 to 5) in the upper flange 17.

10

- As can be seen the upper resilient strip 22 is secured in position on the flange 17 by a mounting screw or rivet 42 which passes through a suitably formed hole 43 in the spring strip 23 and into a blind hole 44 in the flange 17. A similar fastening retains the lower spring strip 24 to the face of the flange 18. As can be seen in Figure 6 the
- 15 flange 18 is provided with shallow recesses 45, 46 in register with the openings 21 such that there is a small open space between the flange 18 and the strip 24 about each opening 21.

- In Figure 6 a different embodiment of toggle clamp is illustrated from that of Figures
- 20 1 to 5, comprising a plastics combined toggle clamp body and lever 47 pivotally connected to a tension link 48 in the form of an elongate rod of circular section having two transversely projecting T-shape ends 49, 50 at opposite ends thereof, the latter being engaged in aligned openings 51 in the toggle clamp body 47 to allow pivotal
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turning movement between the toggle clamp body 47 and the tension link 48.

Upon assembling the casing the T-shape end 49 of the tension link 48 is first introduced through the opening 23 in the spring strip 22, and then turned through 90° to align the T-shape end 49 with the opening 41 in the flange 17, it is then turned back through 90° to allow the T-shape end 49 to pass through the aligned openings 21 and 25 in the flange 18 and the lower spring strip 24. Thereafter the tension link 48, and toggle clamp body 47, are turned through 90° again to orientate the T-shape end 29 transversely with respect to the openings 21, 25 to engage this end against the under face of the spring strip 25. On turning the toggle clamp body 47 about the axis defined by the pivot 51 tension is applied to the tension link 48 in the known way, causing the spring strip 24 to flex into the cavity 45 thereby applying a re-storing force to hold the toggle clamp 47 in its clamping position and also to accommodate dimensional variation due to manufacturing tolerances in the components.

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Figures 7a, 7b and 7c show a similar toggle clamp structure to that illustrated in Figure 6, but in which the resilient forces are exerted not by spring strips 22, 24 but by curved resilient springs 52, 53 having central openings 54, 55 through which the tension link 48 can be passed. Such a toggle clamp is particularly useful in confined positions, for example at the ends of the casing 11 or between the two cable entry ports 14, 15 where there is the short narrow space indicated 60 in Figure 2. Because the tension link 22 passes through aligned openings in co-operating members it is not necessary to have components of the toggle clamp passing beyond the perimeters of

the flanges, which allows the toggle clamp to be located in the position 60 illustrated in Figure 2 where a conventional toggle clamp would not be usable.

Figure 8 illustrates an alternative embodiment of toggle clamp in which a tension link  
5 61 is formed as a generally C-shape member with a bight portion 63 and two opposite arms 64, 65 the former of which carries transverse spigots 66, 67 and the latter of which constitutes the hook end for engagement of one of the closure casing members. The toggle clamp body comprises a single block 68 having a slot 69 defining two parallel flanks 70, 71 in which are formed two open ended U-shaped slots 72, 73 for  
10 receiving the transverse spigots 66, 67. As in the previous embodiments the resilience for retaining the toggle clamp in its closure position is provided by spring strips 74, 75 lying against opposite faces of the mating flanges 76, 77, shown schematically in Figure 8 as part only of the overall flange. Alternatively, however, the C-shape tension member 61 may have a degree of resilience allowing bending of the bight  
15 portion 63 to provide the degree of resilience needed for operation of the toggle clamp.

Figures 9 and 10 illustrate a further embodiment of the invention in which the tension link 78 is in the form of a flat C-shape member and the toggle clamp body 79 has a  
20 slot spanned by a pin 80 for engaging one arm of the C-shape member 78. Figures 9 and 10 also illustrate the flexing of the resilient strips such as the strips 74, 75 in the embodiment of Figure 8 or the strips 22, 24 in the embodiment of Figures 1 and 2.

## CLAIMS

1. A closure casing having two co-operating closure members defining an  
5 enclosed space between them when in a juxtaposed closure position, in which there  
are provided means for holding the closure members together in the closure position  
comprising at least one over-centre or toggle clamp mechanism one part of which  
passes through openings in the closure members which are aligned when the closure  
members are in the said closure position, and engages a face of the closure member  
10 remote from the other part of the toggle clamp mechanism.
2. A closure casing according to Claim 1, in which at least one of the closure  
members has a resilient element engageable by a part of the said toggle clamp  
mechanism and operable to apply a resilient resistance to the clamping/movement  
15 thereof whereby to hold the clamp in its locking position when moved thereto against  
the resistance exerted by the resilient element.
3. A closure casing according to Claim 2, in which the resilient element is a  
laminar resilient strip overlying a surface portion of the casing.
- 20 4. A closure casing according to Claim 3, in which the said closure members are  
co-operating half shells having respective flanges around perimetral rims thereof  
which are brought together when the casing is closed, and in which the said resilient

element comprises a strip or stringer lying along the length of at least one flange.

5. A closure casing according to Claim 4, in which the flanges have a cavity therein adjacent the or each opening through which passes the said one part of the  
5 toggle clamp mechanism and across which the said resilient strip spans.

6. A closure casing according to any preceding Claim, in which the said one part of the toggle clamp mechanism has a transverse projection for engaging the face of the closure member remote from the other part of toggle clamp mechanism, the said  
10 transverse projection being in the form of two oppositely directed substantially symmetrical projections for engaging opposite sides of an opening in the said closure member.

7. A closure casing according to any preceding Claim, in which there are a  
15 plurality of openings in the said closure members and a plurality of toggle clamp mechanisms spaced around at least part of the periphery of the closure members.

8. A closure casing according to any of Claims 1 to 5 or 7, in which the said one part of the toggle clamp mechanism has a hooked end for engagement of the said face  
20 of the closure member remote from the other part of the clamp mechanism.

9. A closure casing according to any preceding Claim, in which the said other part of the toggle clamp mechanism comprises a body portion having two parallel

sides with respective aligned openings or cavities for receiving respective pivot pins of the said one member such that the said one member is located, in use, between the said two parallel sides, and an operating tab or lever which lies substantially parallel to the surface of the co-operating closure member when the clamp is in its locking position.

10. A closure casing according to Claim 9, in which the said body portion of the said other part of the toggle clamp mechanism has a face extending generally transversely of the operating tab or lever serving as a release member against which, in use, is applied a force to release the clamp from its locking position.

11. A closure casing according to any preceding Claim having a plurality of toggle clamps spaced along at least part of the perimeter thereof and a sealing member located inwardly of the clamps for sealing the interior volume of the casing when closed.

12. A closure casing having two co-operating closure members defining an enclosed space between them when in a juxtaposed closure position, in which there are provided closure means in the form of at least one toggle clamp mechanism comprising two relatively turnable parts which can be moved in relation to one another between an over-centre clamping or locking position in which the two parts apply a closure pressure to the two co-operating closure members, and a release position, and in which at least one of the closure members carries a resilient element



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which is stressed by the toggle clamp mechanism when the parts thereof are in its clamping position, whereby to apply a resisting force to maintain the parts of the toggle clamp in their over-centre position and the two closure members pressed against one another.

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13. An over-centre or toggle clamp mechanism for holding together two co-operating members of a closure casing, comprising two clamp parts which are pivotally interengaged or interengageable, one clamp part being adapted to pass through aligned openings in the said two co-operating closure members and engage  
10 the closure member remote from the other clamp part.

14. An over-centre or toggle clamp mechanism according to Claim 11, in which the said one clamp part has a transverse projection at or adjacent one end thereof and is turnable about an axis parallel to its length whereby to turn the transverse projection  
15 between engagement and release positions with respect to the said remote closure member.

15. A fibre optic splice closure casing of the type having two closure members which fit together around respective perimetral rims, at least one of the members  
20 having a surrounding flange with a plurality of openings matching corresponding openings in the perimetral region of the other member, and a plurality of toggle clamps for holding the closure members together, each passing through a pair of said openings in the closure members.



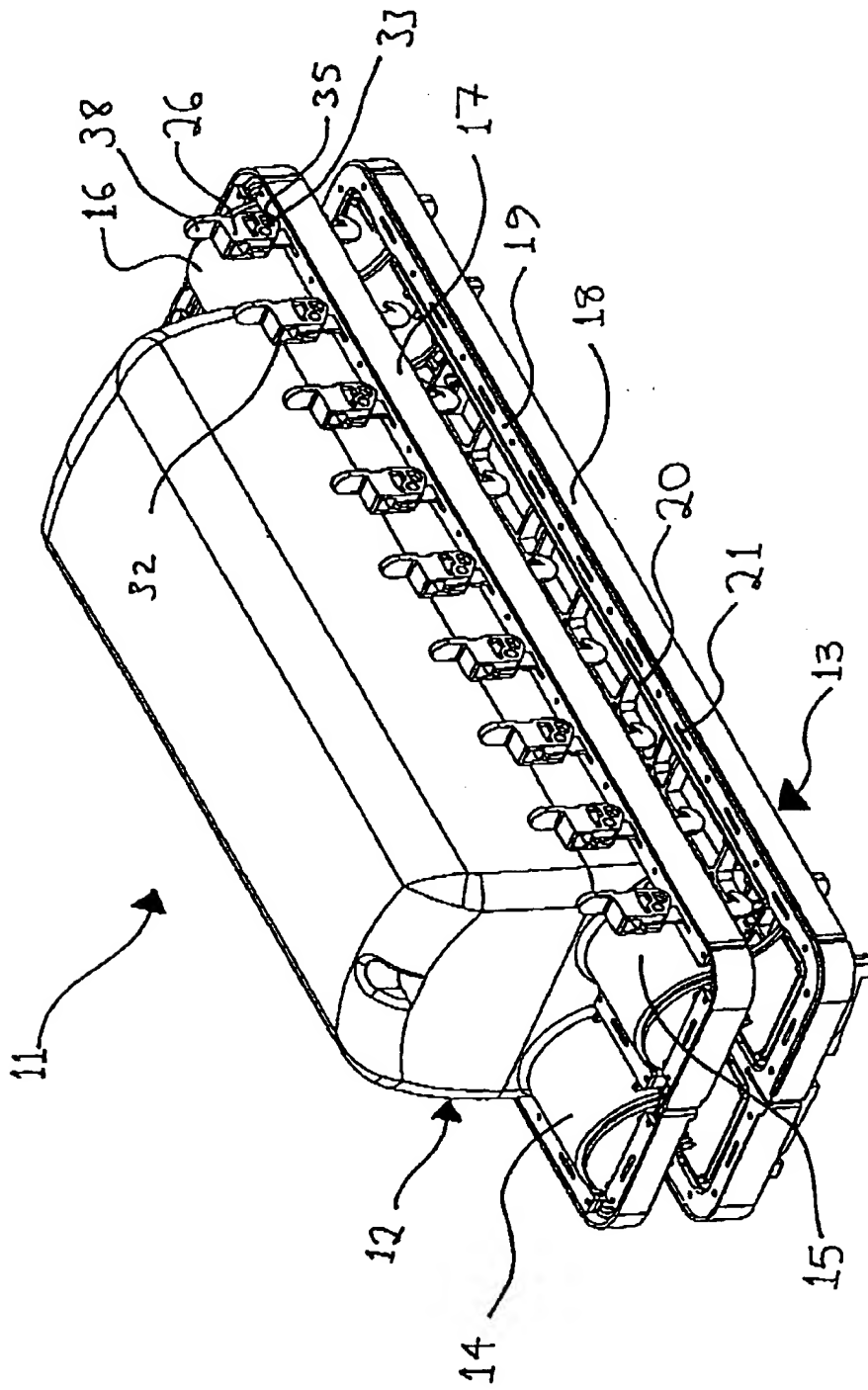
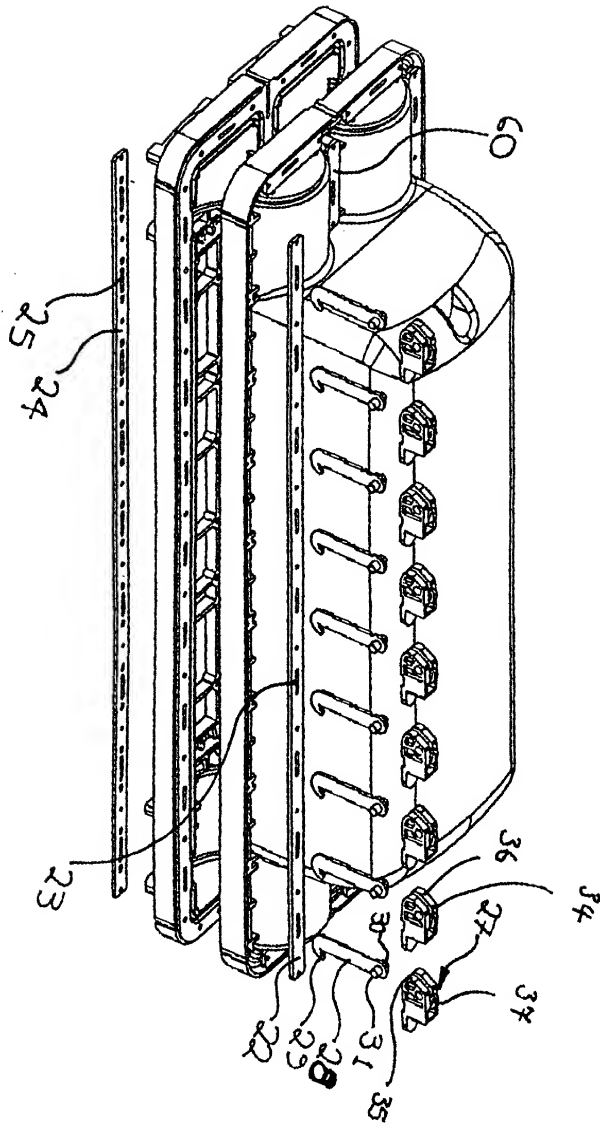


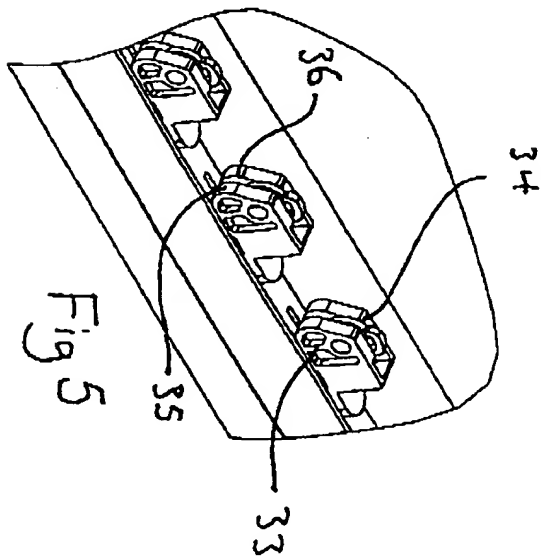
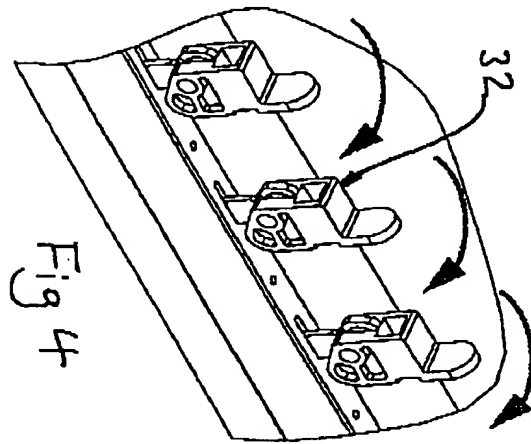
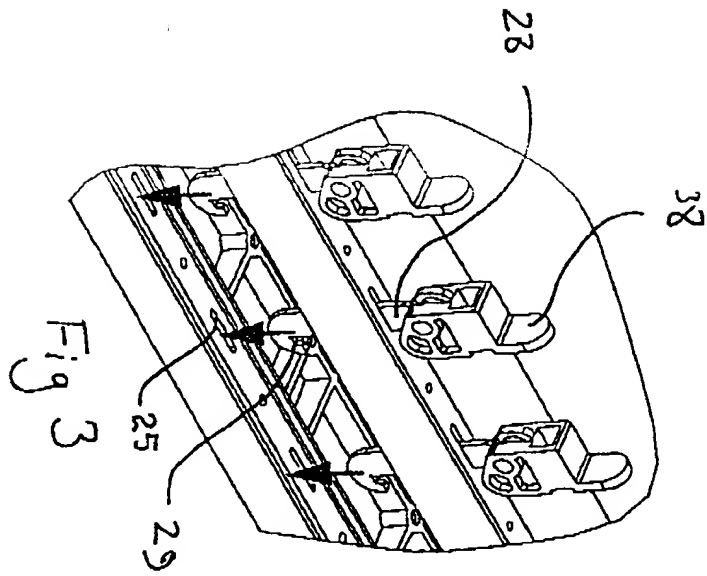
Fig 1



Fig 2











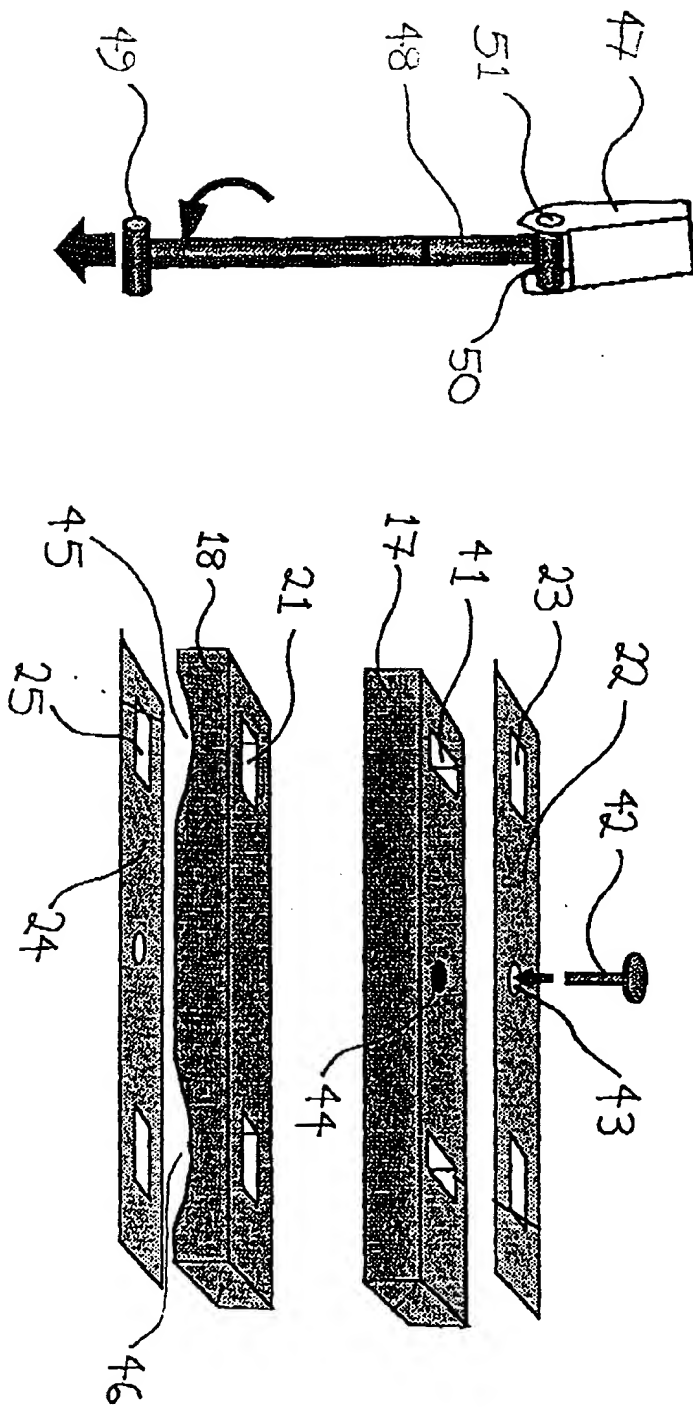
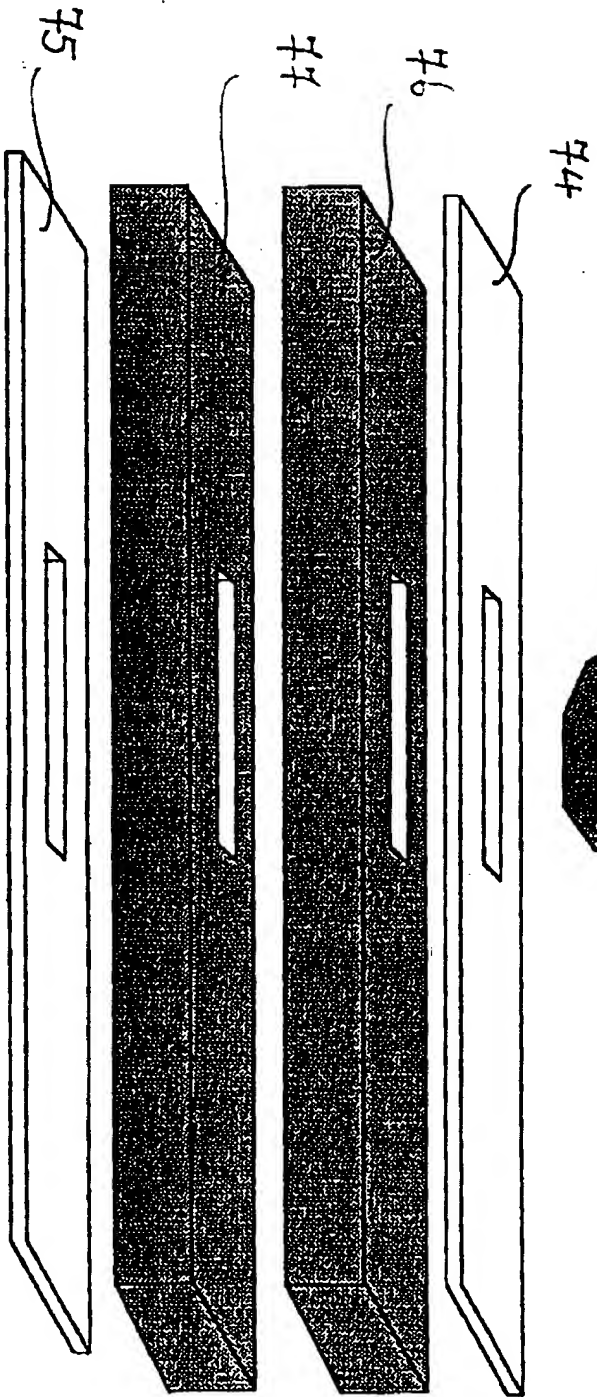
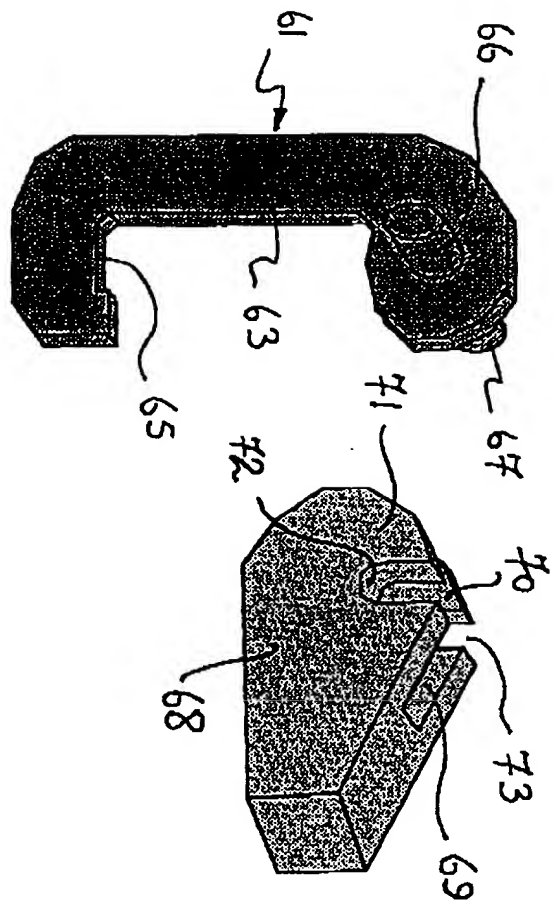
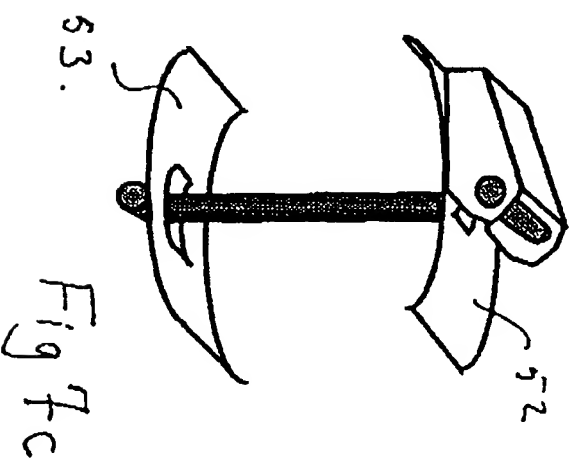
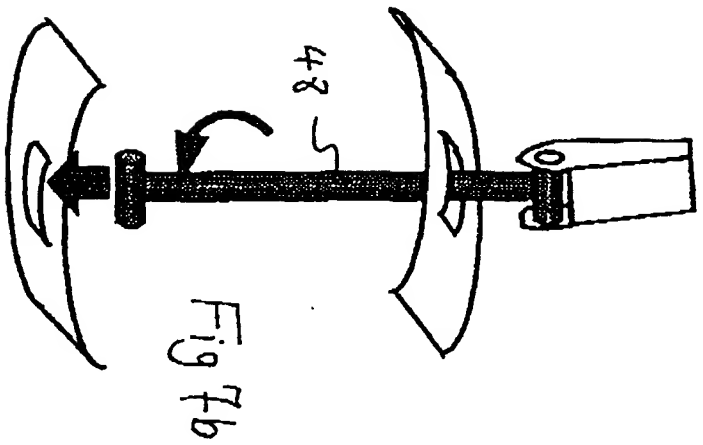
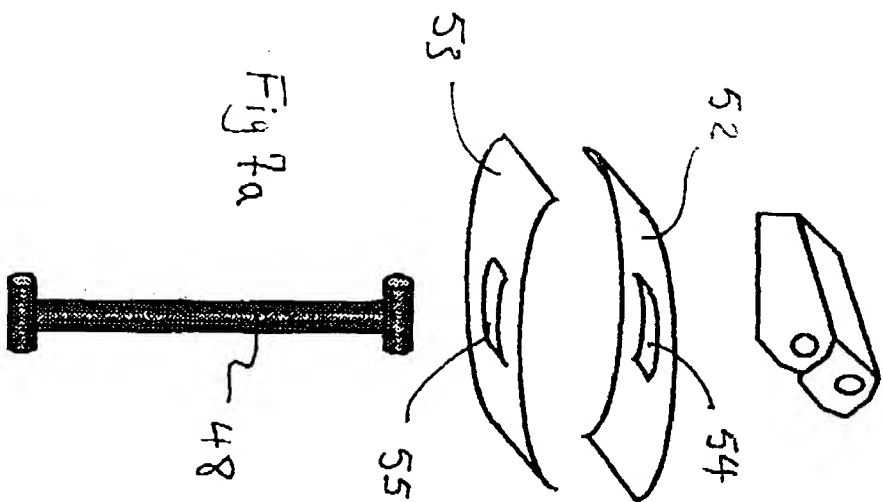


Fig 6











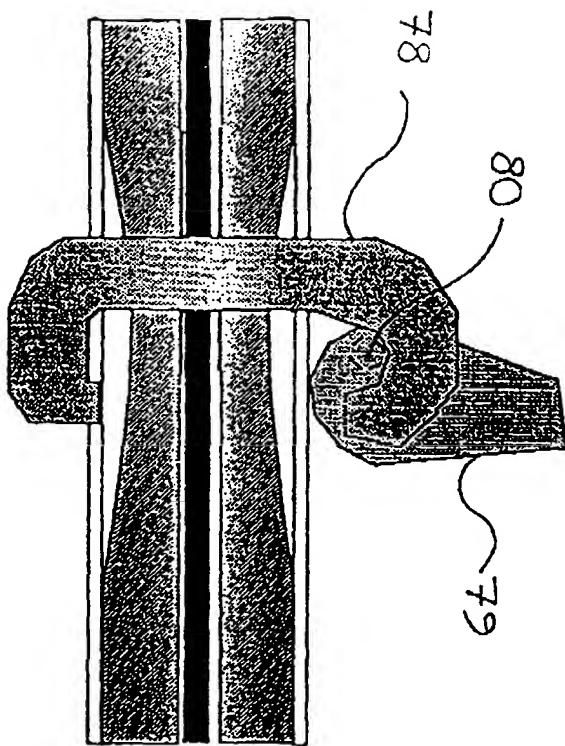


Fig 9

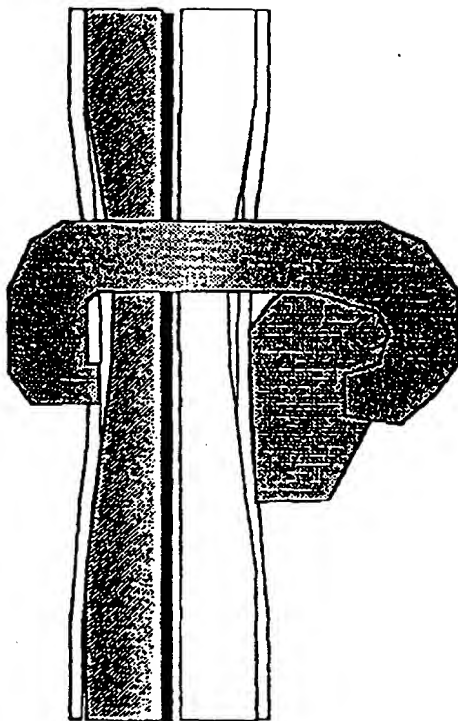


Fig 10

7/7

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18/4/77